

BAB XV

PERENCANAAN KUDA-KUDA

15.1 Pembebanan Kuda - kuda

- Penutup atap Genteng
- Berat penutup atap $w_g := 50 \text{ kg/m}^2$
- jarak antar gording $l_g := 120 \text{ cm}$
- bentang gording $l_k := 360 \text{ cm}$
- sudut kemiringan 42°

Gording profil C dengan ukuran : $150 \times 50 \times 20 \times 2,3$

$W := 4.96 \text{ kg/m}$

Mutu Baja BJ 37

$f_y := 240 \text{ Mpa}$

$f_u := 370 \text{ Mpa}$

- Beban Mati

berat gording	$W = 4.96 \text{ kg/m}$	
berat genteng, reng, dan usuk (PPIUG 1971)	$w_g := 50 \cdot 1.2 = 60$	kg/m
	$wt := W + w_g = 64.96$	kg/m
berat pengikat 10 %	$wp := 0.1 \cdot wt = 6.5$	kg/m
berat plafond & penggantung	$w_{pl} := 18$	kg/m
	$q_d := wt + wp + w_{pl} = 89.46$	kg/m

$$Q_d := 89.46 \cdot \frac{1.2}{3.6} = 29.82 \text{ kg/m}$$

- Beban Hidup

1. Beban hidup air hujan diambil 6.4 kg/m^2

$$PL1 := 6.4 \cdot 1.2 = 7.68 \text{ kg/m}$$

2. Beban hidup pekerja diambil 100 kg terpusat

- Beban Angin

Beban angin tekan hasil perhitungan gording

$$P_w := 11 \cdot 1.2 = 13.2 \text{ kg/m}$$

untuk berat sendiri profil kuda - kuda baja akan dihitung oleh program SAP 2000.

- Kombinasi Beban

Kombinasi beban yang digunakan sesuai SNI 02-1729-2002 yakni :

$$1,2 \text{ DL} + 1 \text{ LL} + 1,3 \text{ W}$$

15.2 Analisa Struktur Kuda - kuda WF 200.100.5,5.8

Section Properties :

$W_k := 21.3 \text{ kg}$	$A_k := 27.16 \text{ cm}^2$	$Z_x := 200 \text{ cm}^3$
$d := 200 \text{ mm}$	$i_x := 8.24 \text{ cm}$	$Z_y := 41.4 \text{ cm}^3$
$b := 100 \text{ mm}$	$i_y := 2.22 \text{ cm}$	$S_x := 184 \text{ cm}^3$
$t_f := 8 \text{ mm}$	$I_x := 1840 \text{ cm}^4$	$S_y := 26.8 \text{ cm}^3$
$t_w := 5.5 \text{ mm}$	$I_y := 134 \text{ cm}^4$	
$r := 11 \text{ mm}$	$L_{xk} := 520 \text{ cm}$	
$h := d - 2 \cdot (t_f + r) = 162 \text{ mm}$		

Mutu Baja :

$f_y := 240 \text{ Mpa}$	$G := 80000 \text{ Mpa}$
$f_u := 370 \text{ Mpa}$	$E := 200000 \text{ Mpa}$

- Kontrol Kuat Geser

$$\frac{h}{t_w} = 29.45 \quad \frac{1100}{\sqrt{f_y}} = 71$$

karena $\frac{h}{t_w} < \frac{1100}{\sqrt{f_y}}$ maka

$$V_n := 0.6 \cdot 10 \cdot f_y \cdot \left(\frac{h \cdot t_w}{100} \right) = 12830.4 \text{ kg}$$

$$\phi V_n := 0.9 \cdot V_n = 11547 \text{ kg}$$

Dari hasil output SAP didapatkan nilai :

$$V_u := 2067.38 \text{ kg} \quad \blacksquare < \blacksquare \quad \phi V_n = 11547.36 \text{ kg} \quad \text{OK!!}$$

- Kontrol Kuat Momen Lentur

- Local Buckling

SAYAP

$$\frac{b}{2 \cdot t_f} = 6.25$$

$$\frac{170}{\sqrt{f_y}} = 10.97$$

BADAN

$$\frac{h}{t_w} = 29.45$$

$$\frac{1680}{\sqrt{f_y}} = 108.44$$

Penampang kompak sehingga $M_n = M_p := Z_x \cdot 2500 = 500000 \text{ kgcm}$

- Lateral Buckling

$$L_b := 100 \text{ cm}$$

Dari Tabel Ir. Marwan Ibrahim perhitungan panjang L_p dan L_r didapatkan :

BJ 37 didapatkan nilai $L_p := 112.79 \text{ cm}$

$$L_r := 336 \text{ cm}$$

$L_b < L_p$ sehingga termasuk bentang pendek $M_n = \phi M_p$

Dari hasil output SAP didapatkan nilai :

$$M_{\max} := 2915.6 \text{ kgm}$$

$$\phi M_n := 0.9 \cdot \frac{M_p}{100} = 4500 \text{ kgm}$$

Dan didapatkan nilai $M_{\max} < \phi M_n$ OK!!

- KONTROL TEGANGAN KIP

Data perencanaan $L_g := 1200 \text{ mm}$

$$G = 80000 \text{ Mpa}$$

$$J := \frac{1}{3} \cdot b \cdot t_f^3 = 17066.67 \text{ mm}^4$$

$$I_y = 1340000 \text{ mm}^4$$

$$M_{\max} = 28602036 \text{ Nmm}$$

$$M_{kip} := \sqrt{\frac{\pi^2 \cdot E \cdot I_y \cdot G \cdot J}{L_g^2}} = 50078967.96 \text{ Nmm}$$

$$\sigma_{kip} := \frac{M_{kip}}{b \cdot t_f \cdot h} = 386.41 \text{ Mpa}$$

Tegangan yang terjadi adalah

$$\sigma_t := \frac{M_{\max}}{b \cdot t_f \cdot h} = 220.69 \text{ Mpa} \quad \sigma_t < \sigma_{kip} = 386.41 \text{ Mpa} \quad \text{OK!!}$$

SYARAT PENAMPANG TIDAK BERUBAH BENTUK

$$\frac{h}{t_w} = 29.45 \text{ kurang dari } 75$$

$$\frac{L_g}{h} = 7.41 \text{ kurang dari } 1.25 \cdot \frac{b}{t_f} = 15.63$$

Jadi tidak terjadi perubahan penampang

- KONTROL TEKUK

Panjang Kuda-kuda $L_{kx} := 3600 \text{ mm}$

Jarak gording $L_{ky} := 1200 \text{ mm}$

Data perencanaan :

$$i_x = 82.4 \text{ mm}$$

$$A_g = 2716 \text{ mm}^2$$

$$i_y = 22.2 \text{ mm}$$

$$\phi M_{nx} = 44145000 \quad \text{Nmm}$$

Output SAP didapatkan :

$$P_u := 39017.36 \quad \text{N}$$

$$M_{nt} := M_{max} = 28602036 \quad \text{Nmm}$$

$$M_{lt} := M_{nt} = 28602036 \quad \text{Nmm}$$

$$\lambda_x := \frac{L_{kx}}{i_x} = 43.69$$

$$N_{crbx} := \frac{\pi^2 \cdot E \cdot A_g}{\lambda_x^2} = 2808723.12 \quad \text{N}$$

$$N_{crsx} := N_{crbx} = 2808723.12 \quad \text{N}$$

$$\lambda_y := \frac{L_{ky}}{i_y} = 54.05$$

Tekuk kritis arah y karena $\lambda_y > \lambda_x$ sehingga $\lambda := \lambda_y = 54.05$

$$\lambda_c := \frac{\lambda}{\pi} \cdot \sqrt{\frac{f_y}{E}} = 0.6 \quad \text{karena} \quad 1.2 > \lambda_c > 0.25$$

$$\text{sehingga didapatkan nilai} \quad \omega := \frac{1.43}{1.6 - 0.67 \cdot \lambda_c} = 1.19$$

$$P_n := \frac{f_y \cdot A_g}{\omega} = 547299.03 \quad \text{N}$$

$$\frac{P_u}{0.85 P_n} = 0.084 \quad \text{kurang dari 0.2}$$

- Menentukan M_{ux}

Untuk elemen tidak bergoyang

β_m adalah perbandingan momen terkecil dan momen terbesar di ujung-ujung komponen

$$\beta_m := 0$$

$$C_m := 0.6 - 0.4 \cdot \beta_m = 0.6$$

$$\delta_{bx} := \frac{C_m}{1 - \left(\frac{P_u}{N_{crbx}} \right)} = 0.61 \quad \text{harus lebih besar dari 1}$$

$$\text{Jadi diambil nilai} \quad \delta_{bx} := 1$$

$$\delta_{bx} \cdot M_{nt} = 28602036 \quad \text{Nmm}$$

$$M_{ux} := \delta_{bx} \cdot M_{nt} = 28602036 \quad \text{Nmm}$$

- KONTROL INTERAKSI BEAM COLUMN

$$\frac{P_u}{\phi P_n} < 0.2$$

$$\frac{P_u}{0.85 P_n} + \left(\frac{M_{ux}}{\phi M_{nx}} + \frac{M_{uy}}{\phi M_{ny}} \right) \leq 1$$

$$\frac{P_u}{0.85 P_n} + \left(\frac{M_{ux}}{\phi M_{nx}} + 0 \right) = 0.73 < 1 \quad \text{OK!!}$$

Profil WF 200.100.5.5.8 bisa digunakan untuk kuda - kuda